# Effects of Supportive Care Bundle on Sleep Variables and physiological Parameters of Premature infants and their Maternal Self-efficacy

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## Abstract

**Background:** Premature infants are prone to suffer multisystem complications, supportive care bundle is a set of nursing intervention used to improve quality of sleep and physiological parameters of premature infant, which can be affective by environmental stress in neonatal intensive care unit. **Aim:** This study aimed to evaluate the effects of supportive care bundle on sleep variables and physiological parameters of premature infants and their maternal self-efficacy. **Design:** A quasi-experimental research design was used for this study. **Setting:** This study was carried out at the neonatal intensive care unit in Sayed Galal Hospital, affiliated to Al-Azhar University. **Sample:** A purposive sample composed of 64 premature infants and their mothers after fulfilling the inclusion criteria. The sample was divided into two equal groups, the study and the control groups (32 each)**. Tools:** Four tools were used in this study: **Tool one:** A structured interviewing questionnaire, it included three parts: a) Characteristics of premature infants and medical history. b) Characteristics of the mothers. c) Questionnaire to assess the mothers' knowledge. **Tool two:** Observational checklist to assess the premature infants' sleep variables. **Tool three:** Physiological parameters assessment of the premature infants by assessing the respiratory rate, heart rate, axillary temperature and oxygen saturation level. **Tool four:** Perceived maternal parenting self-efficacy questionnaire. **Results:** The present study revealed that, after intervention, 65.6% of premature infants in the study group had deep sleep compared with 9.4% in the control group. There was a highly statistically significant difference between both groups atpost intervention ($X^2$=29.067 at P<0.001). There was an improvement in the physiological parameters of the premature infants after intervention in the study group compared with the control group. **Conclusion:** The present study concluded that, the implementation of supportive care bundle improves sleep variables and physiological parameters of premature infants, as well as increases mothers' level of knowledge and their self-efficacy scores in the study group than the control group. **Recommendations:** There is a need to implement strategies of supportive care in NICUs to provide more appropriate premature infant's sleep state and keep stable physiological parameters. Develop an infant care education program for mothers about care of premature infants to improve their knowledge and self-efficacy.

**Key words**: Premature infant, sleep, physiological parameters, supportive care bundle, mother's self-efficacy

## Introduction

Premature infants are borne before the due date, premature birth considered as a major problem in neonatal health is the leading cause of morbidity and mortality. Since they need special medical care and support. As well, some of them should be hospitalized in the neonatal Intensive care units (NICU). One of the objectives of the 2030 Agenda of the United Nations is to decrease this morbidity and mortality. Therefore, clinicians must pay close attention to the health of this vulnerable population **(Vahdati et al., 2017)** and **(Lan et al., 2018)**.

Premature neonates have immature body systems, that lead to increasing the risk of respiratory difficulty in addition to having underdeveloped regulatory center that causes irregular breathing, hypoventilation, and repeated apneic episodes, so they may have physiological problems such as a low respiratory rate (RR), irregular heart rate (HR), low level of oxygen saturation, apnea, and increased gastric residual **(Punthmatharith & Mora, 2018).**

Sleep is a very critical human physiological need and plays a fundamental and dominant role in the growth and development of the neonate. Therefore, sleep problems in premature infants admitted in the NICU are a growing worry. How to safeguard and respect the sleep of premature infants in the NICU, and how to properly evaluate and implement useful care measures have become important for premature infant development **(Lou et al., 2018).**

Neonatal Intensive Care Unit environment is disturbing and harmful to premature infants, continuous exposure to a variety of environmental stimuli, such as bright lights, loud noises, excessive manipulations, repeated invasive and painful procedures, maternal separation, and multiple care in the NICU can negatively affect the premature infant's health, leading to changes in HR and oxygen saturation ($SpO_2$) levels, expanding fluctuations in blood pressure, and increasing restlessness. As well, harmful stimuli that often disrupt and shorten their sleep **(Vahdati et al., 2017)** and **(Chora & de Évora,2019).**

Care bundle is a structured method of intervention resulting in an improvement in patient outcomes. It's a straight forward, small set of evidence-based practical actions or interventions, that once performed reliably, improve patient outcomes **(Robb et al., 2010).** Developmental supportive care is a broad category of interventions designed to minimize the stress placed on the neonates and the family by the NICU environment. The core principles of supportive care are protected sleep, hearing environment, family centered care and activities of daily living **(Elsharkawy, 2014).**

Premature infant can get more sleep time with supportive care bundle (SCB) intervention as gentle touch, position, facilitated tucking holding in flexed position, kangaroo care, non-nutritive sucking, nesting, and swaddling, massage, and calm auditory stimuli. As well, SCB is effective in physiological parameters as helps with thermal regulation, protects against bradycardia, helps in normal breathing patterns maintain transcutaneous oxygen level stability. Generally, SCB generally enhances the health, growth, and development of premature infants and increases neonate survival (**Helaly & Mohammed, 2020)** and **(Correia & Lourenço, 2020).**

The capability of parents to care for premature infants is required to reduce complications, decrease morbidity, preclude disabilities, increase growth anddevelopment of premature infants optimally, and raise parental confidence and perfect parents' self-efficacy. Selecting the right educational method may enhance the capability of parents to appropriately care for and supply developmental care for premature infants **(Zakaria et al., 2020).**

Planned SCB intervention is to improve mothers' experience and self-efficacy and to reduce the length of stay of premature infants in NICU. Active mother involvement in premature infant caregiving leads to secure mother premature infant attachment. As well, NICU interventions that encourage maternal self-efficacy and physical and emotional intimacy between parents and premature infants dramatically, increase the long-term quality of life for these premature infants **(Franck et al., 2019).**

Neonatal nurses have a crucial role in improving the quality of care of premature infants and providing them with comfort measures in order to improve respiratory rate, heart rate and oxygen saturation and promote good sleep. Positioning neonates in a good body

alignment and changing body position regularly are essential components **(Babaei et al., 2019).**

Neonatal nurses are an integral part of premature infants' care, It is the duty of nurses to put into practice measures that safeguard and encourage quite sleep of premature infant. They can inspire mothers to provide care and assist mothers in establishing mutual relationship with their premature infants. Nurses can provide mother with guide, advise, help and counseling in regards to the behavior cues and parenting abilities to care of their of premature infants. If nurses allows mothers to care for premature infant during stay in the hospital, that will help to ensure that the mothers can be able to persist on after discharge **(Correia & Lourenço, 2020).**

## Significance of the study

Prematurity has been one of the major causes of neonatal mortality and morbidity. Worldwide, premature birth is seen in almost 11.1% of all pregnancies. Premature birth represents approximately 70% of neonatal and 36% of infant deaths. As premature neonates are a vulnerable population, they require highly specialized nursing interventions with advanced technology **(Das et al., 2020).** Globally, there are about 150,000 premature infants each year, ranking for the incidence of 1/10 **(Huang et al., 2021).** In Egypt, premature birth complications were found to cause 38% of neonatal deaths **(Muhe et al., 2019)**.

Premature infants in the NICUs rarely reach the deep sleep and quietly awake states, which are required for healthy devel0pment, studies indicating an average of 132 to 234 **(Liao et al., 2018)** sleep disrupti0ns, in a given period of 24 hours in NICU **(Chora & de Évora, 2019)** and **(Mony et al., 2019)**. As well, the environment can affect the development and functioning of the central nervous system (CNS) in premature infants (CNS). Changes in parameters such as HR, RR, color, blood pressure and $SpO_2$ show whether there is any physiological instability**(Sumathy 2020).**

Premature infants need to regulate their sleep and wake via decreasing environmental noise, stress and regulating nursing care activities. Numerous supportive measures have been proven to assist in stabilizing physiological parameters of premature infants and maintain sleep. Therefore, this study would provide SCB interventions to help in the improvement of deep sleep and quiet awake states for premature infants, relieve the negative influences of sleep disruption in the NICU, also, to improve physiological parameters and increase maternal efficacy.

## Operational Definitions

**Supportive care bundle** is a set of evidence based practices' interventions supported by research that when used together causes a significant improvement in premature infants' sleep and physiological parameters and parental self-efficacy.

**Physiological parameters including** blood pressure, body temperature, respiratory rate, heart rate, and oxygen saturation, are used for the assessment of premature infants.

**Sleep variables** deep sleep and quiet awake states of premature infants.

**Efficacy** is attributed to when mothers feel comfortable in performing premature infant caring skills and verbalized that they feel can help their premature infant in times of need**.**

## Aim of study

This study was aimed to assess the effect of SCB on sleep variables and physiological parameters of premature infants and their maternal self-efficacy. This aim was accomplished through the following objectives:

- Assessment of sleep variables and physiological parameters of premature infants.

- Assessment of mother knowledge and self-efficacy.

- Developing and Implement of SCB intervention.

- Evaluate the effect of SCB on sleep variables and physiological parameters of

premature infants and their maternal knowledge and self-efficacy.

**Research hypotheses**

To fulfill the aim of the present study, the following hypotheses were tested:

$H_1$: Premature infants who receive SCB will have better sleep variables than those who do not and that there will be a statistically significant difference between the study and control groups.

$H_2$: Premature infants who receive SCB will have m0re stable physiological parameters than those who do not and that there will be a statistically significant difference between the study and control groups.

$H_3$: There will be a significant improvement in mean knowledge scores of mothers and mean maternal self-efficacy scores after SCB intervention in the study group than those in the control group.

$H_4$: There will be a significant correlation between mothers' knowledge and self-efficacy.

**Subjects and Methods**

**1-Technical Design**

**1.1 Research design:**

A quasi-experimental was utilized in this study using study and control groups, pre-test and post-test interventions.

**1.2 Setting:**

The study was conducted in NICU which include fifteen incubator and /or beds in Sayed Galal Hospital, affiliated to Al-Azhar University.

**1.3 Sampling:**

**Type of sample:** A purposive sample

**Sample size**

Based on data from the literature **(Möller et al., 2019)**, considering level of significance of 5%, and power of study of 80%, the sample size can be calculated using the following formula: $n = [(Z\alpha/2 + Z\beta)^2 \times \{2(SD)^2\}]/$ (mean difference between the two groups)$^2$, where, SD = standard deviation obtained from the previous study; $Z\alpha/2$, for 5% this is 1.96; and $Z\beta$, for 80% this is 0.84. Therefore, $n= [(1.96 + 0.84)^2 \times \{2(5.73)^2\}]/ (4.05)^2=31.4$. Based on the above mentioned formula, the study sample consisted of 64 of mothers and their premature infants.

The study sample randomly divided into two equal groups, the control group (32) receive only usual NICU care, and the study (32) who receive SCB (usual NICU care + positioning + gentle touch + non-nutritive sucking + facilitated tucking + modulating infant states + Kangaroo care (KC) + oral sucrose).

The study sample was selected after fulfilling **the premature infants' inclusion criteria**, which include age between 31 and 37 weeks of gestation, having a birth weight of at least 1500 grams, being a feeder (fed orally), being at least two days old after birth, breathing spontaneous without need the aid of a machine, having an APGAR score of at least four, and being fed every two hours, both gender. **Exclusion criteria were:** Premature infants who need ventilator support, have congenital anomalies, neurological defects, birth weight less than 1500 grams, and have nosocomial sepsis were excluded from the study.

**Mothers' inclusion criteria:** Mothers who are attending the aforementioned setting to care of their premature infants, regardless of their level of education or age.

**1.4 Tools and techniques of data collection**

**Tool one : A Structured Interviewing Questionnaire:**

It was developed by researchers after reviewing over pertinent literature. It was written in simple Arabic language, contains the following:

**Part I: Characteristics of premature infants and medical history:** Collected from premature infants medical and nursing record including gestational age, diagnosis, gender, birth weight and method of feeding.

**Part II Characteristics of the mothers including** level of education, age, occupation, family size, and residence.

**Part III: Questionnaire to assess the mothers' knowledge:** The questionnaire was created by researchers based on related literature **Royal College of Occupational Therapists (2017)** and **Zakaria et al., (2020)**, used before and after implementation of SCB intervention. The questionnaire contain of 60 closed and open ended questions concerning to sleep state, positioning, gentle touch, oral sucrose, hunger cues, feeding cues, non- nutritive sucking, facilitated tucking, modulating premature infant and KC.

**Scoring system**

A grading system for mothers' knowledge was created; the correct response received a score (1), while the incorrect or unknowable response received a score (zero). To determine the mothers' total knowledge score, the scores for each question were summed up. The total score ranged from 0-60, converted to percentages, and interpreted as the following: < 50% score < 30 regarded poor, 50% -< 60% score 30-<36 regarded average, and ≥ 60% score ≥ 36 regarded good.

**Tool two: Observational Checklist to Assess the Premature Infants' Sleep Variables:** It was developed by **Als, (1999)**. The observational checklist was consisted of six different level of sleep sate, including light and deep sleep, drowsy, softly awake and alert, active awake and agitated as well as highly agitated and crying. A variety of behavioral cues, such as facial expressions, breathing patterns, body, eye, mouth movements, skin color, and different sounds, help to define each state level.

**Scoring system**

**Total scoring system for sleep variables:**

The six states were ranked as follows:

- State 1: Deep sleep with closed eyes, no eye movements, regular breathing, and no spontane0us movements.

- State 2: Light sleep with closed eyes, eye movements, irregular breathing, and slight spontaneous movements.

- State 3: Drowsy with eyes opened or closed, eye movements, irregular breathing, and sporadic spontaneous movements.

- State 4: Quietly awake/alert with eyes opened and slight spontaneous movement.

- State 5: Actively awake and aroused with brief periods of being worried and active spontaneous movement.

- State 6: Highly aroused and agitated/crying with violent intense crying and active spontaneous movement.

**Tool three: Physiological Parameters Assessment of the Premature Infants** for assessing the RR, HR, axillary temperature, and $SpO_2$ level.

**Oxygen saturation level:** It was indexed via pulse oximeter levels acquired from medical and nursing records, also by observation of pulse oximeter device attached to the premature infants' leg.

**Tool four: Perceived Maternal Parenting Self-Efficacy Questionnaire**

It was adapted from **Barnes and Adamson-Macedo (2007)**, and it was utilized to evaluate perceptions of mothers' to their self-efficacy in giving care to their premature infants the composed of 20 statements categorized into four subscales including: Care giving, aroused behaviors, signaling and reading behaviors and beliefs. Responses to each statement using three point Likert Scale, rated from 1- 3, with (1) disagree, (2) neutral agree, and (3) agree.

**Scoring system:**

The total self-efficacy score ranged from 20 to 80; the responses of the maternal self-

efficacy were calculated and the total score was graded to higher self-efficacy level (≥60%) with a score ranged from 48-≤ 80, or lower self-efficacy level (<60%) with score ranged from 20-<48. This tool was given to mothers before and after implementation of SCB intervention and before premature infant discharged from the NICU.

**2- Operational Design**

**2.1 Preparatory phase:**

During this phase, the study data collection tools were developed by reviewing the pertinent literature using internet searches, magazines, papers, and books to cover different aspects of the research problem.

**2.2 Reliability of tools:**

The Cronbach's alpha value for the reliability (internal consistency) of the knowledge questionnaire was 0.889 and for the self-efficacy questionnaire was 0.907, while the other second, and third tools were standardized**.**

**2.3 Validity of tools:**

Before tools being used in the study, it were reviewed, evaluated and validated by a panel of three pediatric nursing experts, and their feedback was taken into consideration. The second and third tools were standardized.

**2.4 Pilot study:**

A pilot study was conducted on ten percentage of the premature infants and their mothers who participated in the study to evaluate viability, clarity, and application the tools. Any necessary revisions were performed. Premature infants and their mothers who participated in the pilot study were excluded from the main study samples.

**2.5 Ethical considerations:**

After demonstrating the study aim, duration, and value, the Director of the Hospital and the Head of the NICU gave their consent. additionally, oral approval was gained from the premature infant mother after demonstrating The study aim, and benefitness, and the mother was asserted that data gathered was confidential. The mothers were informed about their rights to agree or refuse the participation of their premature infants in the study without it affecting the care were giving to them. As well, they have a right to leave the study at any time and without providing a rational.

**2.6 Field work:**

Data collection of the present study was carried out in a duration of eight months from the first of May 2020 to the end of December 2020. The researchers were available in the study setting 3days per week from 9.00 a.m. to 12.00 noon. The researchers introduced herself and established a good rapport with the mothers. they explained the aim of the study to the mother and obtained their consent. On the same day, baseline physiological parameters were assessed before intervention.

Individual interviews with each mother were conducted using the tools of the study mentioned previously. The questionnaires took 15 minutes to complete responses and the researcher marked both the questionnaire and the responses.

The premature infants were divided int0 two identical groups, the control (32) who receive only usual NICU care, and the study (32) who receive SCB (usual NICU care + positioning + gentle touch + non-nutritive sucking + oral sucrose + facilitated tucking + modulating infant states and KC). Additionally, mothers in this group receive instruction regarding sleep variables, positioning, gentle touch, non-nutritive sucking, hunger cues, oral sucrose, and feeding cues, facilitated tucking, modulating infant states, and routine KC, and how to provide care to premature infants.

Nurses in NICU and mothers were instructed to consistently use the SCB intervention for 24 hour care of the premature infants on three shifts (day, evening, & night). The premature infants receiving the SCB were under the care of at least one skilled nurse working in each shift during the study period.

The researchers met with the nurses who were caring for the premature infants to make sure that they consistently performed and documented the caregiving activities in accordance with the NICU's established protocols.

The researchers, and well-trained nurses, were observing and recorded the premature infants' wake and sleep state at 1 minute times for 3 hours during premature infants are sleeping. All variables were recorded on an observation sheet. During the three hours of observation, the total frequencies of sleep, wakefulness, fussing and crying were calculated. The daily review of infant's medical and nursing records was part of the researchers' ongoing effort to gather information on medical and caregiving activities.

**The application of SCB was carried out in four phases:**

**1- Assessment phase**: It consisted of the pretest for assessing mothers' knowledge about SCB and assessing their self-efficacy using tools (1&4), and tools (2&3) to assess the premature infants' sleep variables and physiological parameters.

**2- Planning phase:** It involved designing the SCB intervention topics. The content was consisted of usual NICU care, positioning, KC, gentle touch, non-nutritive sucking, oral sucrose, facilitated tucking, and modulating infant states.

**3- Implementation phase**: The SCB intervention was carried out in 3 sessions; one session to cover the theoretical part, which included the premature infant's feeding technique, and educating the mother on how to assess the premature infant f0r potential feeding on demand. In addition, educate about positioning, KC, gentle touch, non-nutritive sucking, and facilitated tucking. As well, two practical sessions to apply practices regarding SCB intervention. At the beginning of each session, the researchers started by a summary about what was given in the previous session and the objectives of the new one, taking into consideration using simple and clear language to suite the mothers' educational level.

The trained nurses modify the light and noisy levels. As well, the trained nurses and mothers (1) Modulated the premature infant's state by speaking softly and quietly to gradually waken them; (2) they gave the premature infants non-nutritive sucking using a standard silicone pacifier for 2 to 5 minutes. Or the researchers trained the premature infants to perform non-nutritive sucking by using finger while receiving enteral nutrition. (3) Oral feeding was given to the premature infants while they are sucking. (4) In addition, the nurses and mothers were using warm hands to perform gentle touch (placing fingers softly and gently on the premature infant's f0rehead); and (5) facilitated tucking were used (the premature infant was kept in a flexed, midline position with all four limbs close to the body) from 1 minute to 5 minutes. And the mothers were asked to practice KC.

Each session lasted between 30 and 45 minutes and used a variety of teaching strategy, including lectures, discussions, demonstrations, and redemonstrations. Videos, PowerPoint presentations, and handouts were used as media of teaching, and mothers meeting was carried out in a private NICU room.

After all mothers sessions are finished, premature infants were observed as regards their sleep state and physiologicalparameters by the researchers, who observed the signs of good quality sleep (QL) such as absence of body movements, closed eyes, absence of rapid eye movements, regular respiration, heart rate and few brief wakes. The sings of active sleep including eyes closed with rapid movements, the presence of body movements, an irregular heart beat and respiration, brief awakenings, and any movements. The HR was noted, assessed and documented. Oxygen saturation was indexed via pulse oximeter levels acquired from medicaland nursing records, also by observation pulse oximeter device connected to the premature infants' leg. Visually, regularity of breathing was noted. The existence of criteria linked any sleep phase for at least one minute was known as the starting of that phase and

their entire cessation for one minute considered as the end of that phase.

Implementation of SCB intervention was used for two weeks before the premature infant's was discharged from the NICU. The researchers taught the mother how to use this strategy at home following discharge.

**4- Evaluation phase**:

This phase was performed through comparison between both groups pre and post-intervention done using the same pretest tools to assess the effect of the applying a SCB intervention on premature infants and their mothers.

**3. Administrative Design:**

The administrators of the study setting at Sayed Galal Al-Azhar University Hospital and the Head of the NICU approved to conduct the present study after being informed of its aim, duration, tool used, and beneficent.

**4. Statistical Design:**

The Statistical Package for Social Sciences (SPSS), for Windows, version 24.0 (SPSS, Chicago, IL) was used to conduct all statistical analyses. While categorical data were expressed in terms of number and percentage, continuous data were expressed as mean and standard ± deviation (SD). Using the Chi-square test for variables with categorical data and the r test for correlation between variables, the differences between the two groups were determined. The statistical insignificant were at $P> 0.05$, statistical significance at $P<0.05$ and high significance were at $P < 0.01$.

**Results:**

**Table (1):** Shows that, more than half of the studied premature infants (53.1%) were girls in the study group, and slightly less than two-third (65.6%) were males in the control group with a mean gestational age of 34.0±1.7 weeks in the study group and 34.2±1.6 weeks in the control group. As well, the same table shows that slightly less than two-third (65.6%) in the study group and less than three quarter (71.9%) in the control group were diagnosed with hyperbilirubinemia, and more than one-fifth (21.9%) and less than one-fifth (18.8%) in the study and control groups respectively were diagnosed with respiratory distress syndrome (RDS) followed by minorities in both groups (12.5 & 9.4) respectively were sepsis. Mean birth weight was 2264.0±449.7gm in the study group and 2272 ±447.9 gm in the control group. Less than three quarter (71.9%) in the study group and more than three quarter (78.1%) in the control group oral feedings were given to them. Statistically insignificant differences were detected between both study and control groups for all characteristic items $P>0.05$.

**Table (2):** This table reveals that around two third of studied mothers (68.8% & 66.6%) in the study and control groups respectively were in the age group between 20-<30 years. In addition, slightly less than two-third of mothers (65.6%) in the study group and more than two-third (68.8%) in the control group had secondary level of education. Regarding mothers' occupation, more than three-fifths (62.5%) in study and slightly less than two-third (65.6%) in control groups were housewives. Regarding to mothers' residency, less than three- fifth (56.3%) in the study group residence rural areas, while more than half (53.1%) in the control group were urban residency. There was no statistical significant difference between the both groups of mothers $P>0.05$.

**Table (3):** Clarifies that the difference between two groups was statistically insignificant before SCB implementation ($X^2$= 1.032 at P=0.960) as only 6.3% and 3.1% in study and control groups respectively had deep sleep, which improved after SCB intervention to slightly less than two-third (65.6%) of premature infants in the study group had deep sleep compared with less than one-tenth (9.4%) in the control group. The difference between two groups was highly statistically significant after applying SCB intervention ($X^2$= 29.067 at $P<0.001$).

**Table (4):** Reveals that pre-intervention 87.5% in the study and 84.4% in the control

group were abnormal RR. After intervention most (93.8%) in the study group changed to the normal range compared to more than one-third (34.4%) in the control group. The difference between two groups were highly statistically significant as ($X^2$= 10.092 at P=0.0015).

As well, table (4) shows that the most (90.6%) of studied premature infants in both groups were abnormal HR and body temperature before intervention and the difference between both groups were statistically insignificant. However, after intervention the majority of premature infants changed to normal HR and body temperature in the study group compared to less-one third (28.1) in the control group and there was a highly statistically significant difference ($X^2$= 23.127 at P<0.001).

As regards $SpO_2$ level the same table (4) indicates that three-quarter (75.0%) in the study group and more than two-third (68.8%) in the control group were abnormal range before the intervention, which changed to more than two-third (68.8%) in the study and slightly more than two-fifth (40.6%) in the control group were normal range after intervention and the difference wasstatistically significant ($X^2$=5.107 at P=0.024).

**Figure (1):** Illustrates that, the majority (81.3%) of the mothers in the study group and three-quarter (75%) in the control group had poor knowledge about the SCB before the intervention, while after the intervention less than three-quarter (71%) of the mothers in the study group had good knowledge compared to three quarter of the mothers in the control group who still poor. Post intervention there was a high statistical significance difference between two groups ($X^2$= 41.682 at P< 0.001).

**Figure (2):** Clarifies that, the majority (81.3% & 87.5%) of studied mothers in the study and the control groups respectively were lower self-efficacy before intervention. However, after intervention it was observed that the majority (84.4%) in the study group changed to higher self-efficacy compared with most (90.6%) of mothers in the control group who were still lower self-efficacy. The difference was a highly statistically significant between both groups after intervention ($X^2$= 36.141 at p < 01.001).

**Table (5):** Shows that there was statistical significant positive correlations between mothers' total knowledge score and their self-efficacy scores at pre and post-intervention in both groups.

**Table (1): Characteristics Data Distribution of the Premature Infants in Both Study and Control Groups (n=64)**

| Variables | Study group (n=32) | | Control group (n=32) | | Chi-square test | |
|---|---|---|---|---|---|---|
| | No | % | No | % | $X^2$ | P |
| **Gender** | | | | | | |
| Boys | 15 | 46.9 | 11 | 34.4 | | |
| Girls | 17 | 53.1 | 21 | 65.6 | 2.286 | 0.131 |
| **Birth weight (gm)** | | | | | | |
| 1500 – < 2500 | 20 | 62.5 | 19 | 59.4 | | |
| ≥ 2500 | 12 | 37.5 | 13 | 40.6 | 0.066 | 0.798 |
| Mean ±SD | 2264.0 ±449.7 | | 2272 ±447.9 | | 0.072 | 0.943 |
| **Gestational age (weeks)** | | | | | | |
| 31-< 34 | 11 | 34.4 | 10 | 31.3 | | |
| 34 -≤ 37 | 21 | 65.6 | 22 | 68.8 | 0.071 | 0.790 |
| Mean ±SD | 34.0 ±1.7 | | 34.2 ±1.6 | | 0.384 | 0.702 |
| **Diagnosis on admission** | | | | | | |
| Respiratory distress syndrome | 7 | 21.9 | 6 | 18.8 | | |
| Sepsis | 4 | 12.5 | 3 | 9.4 | | |
| Hyperbilirubinemia | 21 | 65.6 | 23 | 71.9 | 0.311 | 0.856 |
| **Methods of feeding** | | | | | | |
| Oral | 23 | 71.9 | 25 | 78.1 | | |
| Orogastric feeding tube | 9 | 28.1 | 7 | 21.9 | 0.333 | 0.564 |

P > 0.05 Statistically insignificant

**Table (2): Characteristics Data Distribution of the Mothers in Both Study and Control Groups (n=64 )**

| Variables | Study group (n=32) | | Control group (n=32) | | Chi-square test | |
|---|---|---|---|---|---|---|
| | No | % | No | % | $X^2$ | p |
| **Age (years)** | | | | | | |
| < 20 | 6 | 18.8 | 8 | 24.0 | | |
| 20 - <30 | 22 | 68.8 | 21 | 66.6 | | |
| 30 - <40 | 4 | 12.5 | 3 | 9.4 | 0.452 | 0.798 |
| Mean ±SD | 25.0 ±4.9 | | 24.5 ±4.9 | | 0.434 | 0.666 |
| **Educational level** | | | | | | |
| Primary | 1 | 3.1 | 0 | 0.0 | | |
| Preparatory | 3 | 9.4 | 5 | 15.6 | | |
| Secondary | 21 | 65.6 | 22 | 68.8 | | |
| Higher education | 7 | 21.9 | 5 | 15.6 | 1.857 | 0.603 |
| **Mother's occupation** | | | | | | |
| Housewife | 20 | 62.5 | 21 | 65.6 | | |
| Employee | 12 | 37.5 | 11 | 34.4 | 0.068 | 0.795 |
| **Residence** | | | | | | |
| Urban | 14 | 43.8 | 17 | 53.1 | | |
| Rural | 18 | 56.3 | 15 | 46.9 | 0.563 | 0.453 |

P> 0.05 Statistically insignificant

**Table (3): Distribution of Premature Sleep State in Both Study and Control Pre and Post SCB Intervention (n=64)**

| Sleep state | Pre-intervention | | | | Post-intervention | | | |
|---|---|---|---|---|---|---|---|---|
| | Study group (n=32) | | Control group (n=32) | | Study group (n=32) | | Control group (n=32) | |
| | No | % | No | % | No | % | No | % |
| State 1: Deep sleep | 2 | 6.3 | 1 | 3.1 | 21 | 65.6 | 3 | 9.4 |
| State 2: Light sleep | 3 | 9.4 | 4 | 12.5 | 8 | 25.0 | 7 | 21.9 |
| State 3: Drowsy | 7 | 21.9 | 7 | 21.9 | 0 | 0.0 | 6 | 18.8 |
| State 4: Quiet awake/ alert | 5 | 15.6 | 7 | 21.9 | 1 | 3.1 | 7 | 21.9 |
| State 5: Actively awake and aroused | 10 | 31.3 | 8 | 25.0 | 2 | 6.3 | 6 | 18.8 |
| State 6: Highly aroused and agitated/crying | 5 | 15.6 | 5 | 15.6 | 0 | 0.0 | 3 | 9.4 |
| ***Chi-square test*** | ***$X^2$=1.032*** | | ***P=0.960*** | | ***$X^2$=29.067*** | | ***P<0.001*** | |

P> 0.05 Statistically insignificant P< 0.001 Highly statistically significant

**Table 4: Distribution of Premature Infants Physiological Parameters in both Study and Control Groups Pre and Post SCB Intervention (n=64)**

| Physiological parameters | Pre-intervention | | | | Post-intervention | | | |
|---|---|---|---|---|---|---|---|---|
| | Study group (n=32) | | Control group (n=32) | | Study group (n=32) | | Control group (n=32) | |
| | No | % | No | % | No | % | No | % |
| **Respiratory rate** | | | | | | | | |
| Normal range | 4 | 12.5 | 5 | 15.6 | 30 | 93.8 | 11 | 34.4 |
| Abnormal | 28 | 87.5 | 27 | 84.4 | 12 | 37.5 | 21 | 65.6 |
| ***Chi-square test*** | ***$X^2$=0.129*** | | ***P=0.719*** | | ***$X^2$=10.092*** | | ***P=0.0015**** | |
| **Heart rate** | | | | | | | | |
| Normal range | 3 | 9.4 | 3 | 9.4 | 28 | 87.5 | 9 | 28.1 |
| Abnormal | 29 | 90.6 | 29 | 90.6 | 4 | 12.5 | 23 | 71.9 |
| ***Chi-square test*** | ***$X^2$=0*** | | ***P=1.000*** | | ***$X^2$=23.127*** | | ***P<0.001**** | |
| **Body temperature** | | | | | | | | |
| Normal range | 3 | 9.4 | 3 | 9.4 | 28 | 87.5 | 9 | 28.1 |
| Abnormal | 29 | 90.6 | 29 | 90.6 | 4 | 12.5 | 23 | 71.9 |
| ***Chi-square test*** | ***$X^2$=0*** | | ***P=1.000*** | | ***$X^2$=23.127*** | | ***P<0.001**** | |
| **Oxygen saturation** | | | | | | | | |
| Normal range | 8 | 25.0 | 10 | 31.3 | 22 | 68.8 | 13 | 40.6 |
| Abnormal | 24 | 75.0 | 22 | 68.8 | 10 | 31.3 | 19 | 59.4 |
| ***Chi-square test*** | ***$X^2$=0.309*** | | ***P=0.578*** | | ***$X^2$=5.107*** | | ***P=0.024**** | |

P> 0.05 Insignificant P< 0.001 Highly statistically significant

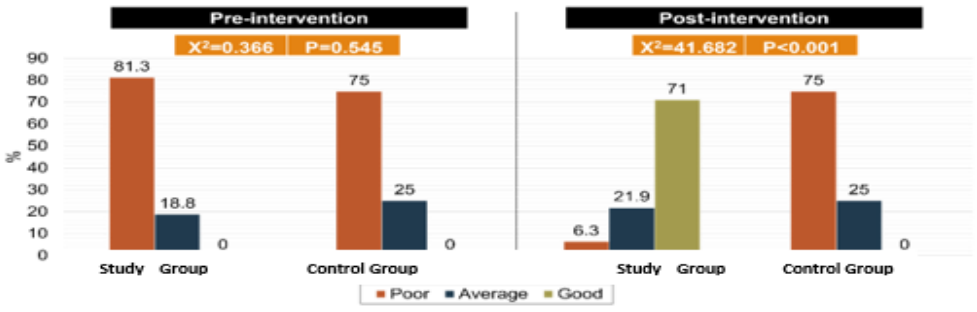


**Figure 1. Percentage of Total Mothers' Knowledge Level about SCB in both Groups Pre and Post Intervention (n=64).**

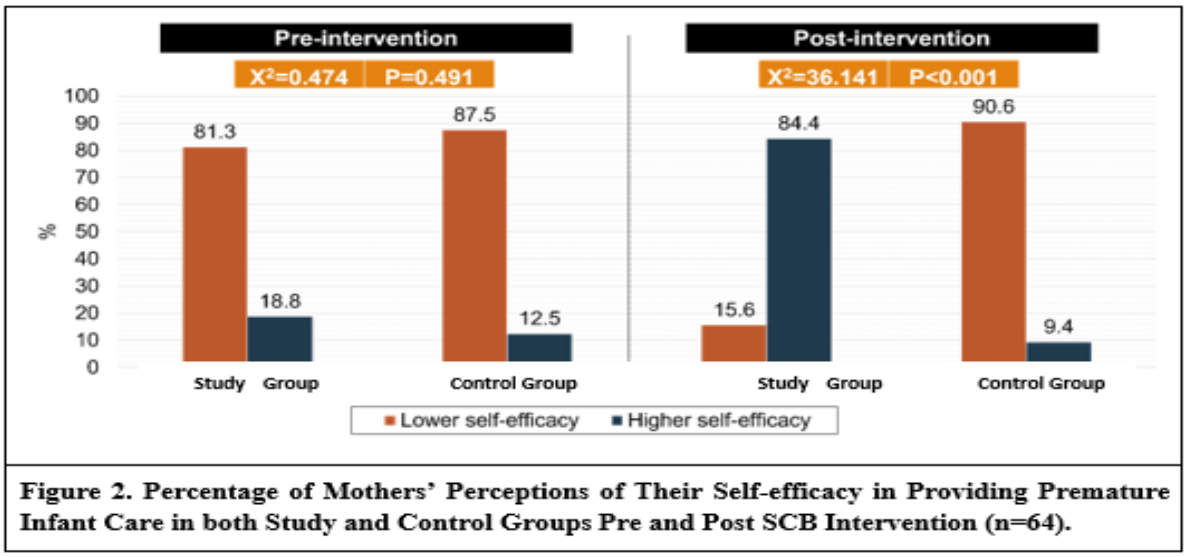


**Figure 2. Percentage of Mothers' Perceptions of Their Self-efficacy in Providing Premature Infant Care in both Study and Control Groups Pre and Post SCB Intervention (n=64).**

**Table (5) Correlations Between Mothers' Total Knowledge and The Total Perceptions of Their Self-Efficacy Scores Pre and Post-Intervention**

| | Study group | | Control group | |
|---|---|---|---|---|
| | r | p | r | p |
| **Correlation pre-intervention** | 0.369 | 0.038* | 0.371 | 0.039* |
| **Correlation post-intervention** | 0.411 | 0.019* | 0.367 | 0.039* |

P< 0.05 Statistically significant

## Discussion

Premature infants need to receive intensive care in NICU to survive. Repeated, painful and stressful stimuli can trouble premature infants' sleep and change their physiological parameters. Therefore, planning care for premature infants is essential for ensuring their survival both inside the hospital and after discharge **(Lan et al., 2018).**

There is a need to implement SCB like positioning, gentle touch, facilitated tucking non-nutritive sucking, oral sucrose feeding, modulating infant states, and KC that provides more appropriate premature infant's sleep state and stable physiological parameters. Therefore, the aim of this study was to evaluate the effect of SCB on sleep variables and physiological parameters of premature infants and their maternal self-efficacy.

Regarding premature infant characteristics, the present study finding showed that, there was no statistical significant differences between two groups of the study according to gender as more than half in both groups were girls. Around two-third of premature infants belong to the gestational age between 34 -≤ 37 weeks. Also, more than half were birth weight between 1500 – < 2500 gm. As well, the difference between two groups was statistically insignificant regarding to method of feeding.

This study findings are nearly similar with those of **Sumathy (2020)** whose study entitled "Effectiveness of nesting technique on posture and physiological parameters" among preterm and low birth weight infants, in India, reported that, the most (92.5%) had their weight between 1.5 and 2.0 kg. As well, **Asghari et al., (2021)** whose study on "The effects of telenursing on stress in mothers with premature infants", in Iran, revealed that, birth weight of the majority of premature infant (86.6% & 88.4%) in both groups were more than 1500 gm and the difference between two groups were statistically insignificant.

However, this study result disagrees with that of **Das et al., (2020)** who studied the "Effect of nesting on selected physiological parameters among preterm babies", in India, found that more than half of the premature infants in the experimental group (59.4%) and the control group (52.8%) belong to the gestational age between 31-34 weeks compared with the current study highest percentage 34 ≤ 37weeks. Also, reported that, less than two third (60% & 63.3%) of premature infant in the experimental and control groups. Less than three-quarter (72.6%) of premature infants in the experimental group and less than half (49.5%) of premature infants in the control have a birth weight between 1001gm-1500gm. This may be related to different studied sample, area, and environmental characteristics.

A relatively high percentage representing around two-thirds of premature infant in the study and control groups were diagnosed with hyperbilirubinemia, followed by respiratory distress syndrome and minorities sepsis, these current study results were supported by those of **Huff et al., (2019)** study entitled "Late preterm infants: Morbidities, mortality, and management recommendations", in the United States, which stated that, Jaundice, difficulty breastfeeding, and infection are the three leading causes of hospital readmission in late-premature infant. This could be related to premature infants' immature body systems which make them more susceptible to illnesses including increased jaundice, respiratory distress, feeding difficulties and infection, all of which increase the incidence of NICUs admissions.

Regarding characteristics of mothers, the results of the current study illustrated that, more than two-third of studied mothers in the study group and two-third in the control group were in the age group range from 20-<30 years. In addition, slightly less than two-third of mothers in the study group and more than two-third in the control group were secondary educational level. Moreover, more than three-fifth and less than two-third of the mothers in the study and control groups respectively were housewives. The difference between two groups were statistically insignificant.

As well, the present study result reported that, less than three-fifth in the study group reside rural area and more than half in the control group reside urban areas. The difference between two groups were statistically insignificant. The findings of the study were nearly similar to those of the study carried out by **Sumathy (2020)** who reported that, more than half of the mothers (55%) were in the age group ranged from 25 to 30 years.

Concerning mothers' level of education level and occupation, the present study results were supported by those of **Jang and Ju (2020)** who studied the "Effects of an infant care education program for mothers of late-preterm infants on parenting confidence, breastfeeding rates, andinfants' growth and readmission rates", in Busan, Korea, who mentioned that, there was statistically insignificant difference between two groups, as more than three-quarter (76.9%) of mothers in experimental group and the majority (85.2%) in the control group were college and beyond, slightly less than two-third (65.4%) in the experimental group and two-third (66.7%) inthe control group were having no job.

Furthermore, these results were inconsistent with those of **Gomes et al., (2021)** whose study entitled "Mothers' knowledge of premature newborn care and application of kangaroo mother care at home", carried out in Northern Brazil, revealed that, two-fifth (40%) of the mothers' age ranged from 19 to 22 years. As for education level, the majority (80%) of mothers had completed high school and 20% had incomplete high school. This may be related to different areas and environmental characteristics of studied samples.

Sleep is a very critical human physiological need and is important for maintaining the homeostasis of the organism as clarified by **(Stokes et al., 2018).** On assessing the sleep variable of premature infants in both the study and the control groups, the current study findings displayed that, before intervention only less than a tenth percent of premature infants in both groups were noticed in a deep sleep state, and the difference between two groups were statistically insignificant before intervention.

This result was supported by those of **Correia and Lourenço (2020)** whose study entitled "Sleep promotion in neonatal intensive care units: Scoping review", in Portugal highlighted that, the NICU's environment displays as disturbing and detrimental to neonatal sleep. This may be due to that the sleep phases of infant who are premature are less organized sleep than in the full-term infant. Generally, compared to full-term infants, premature infants' sleep is frequently distinguished by a lack of sleep cycling, shortened sleep durations, undifferentiated sleep states, and brief periods of quiet sleep. In addition, excessive NICU noise, high lighting, and frequent invasive procedures in the NICU interfere with quiet and deep sleep of premature infants.

However, after intervention, there was improvement in deep sleep state of premature infants in the study group compared with the control group. The difference between two groups were statistically highly significant after intervention. This finding is consistent with that of **Huang et al.,(2021)** who studied the "Effect of non-pharmacological interventions on sleep, in preterm infants, in the neonatal intensive care unit: A protocol for systematic review and network meta-analysis" in China stated that, non-pharmacological interventions have been well highlighted in recent years, which have been used to improve sleep in premature infants in the NICU. This may be due to the effect of a SCB intervention that combines standard NICU care with KC for 45 minutes, positioning, facilitated tucking, oral sucrose, and modulation of premature infant help stabilize premature infants and promote sleep by relieving pain and making it easier for them to get of asleep. Moreover, the NICU environment should be changed and decrease noisy and bright. All of these measures encourage premature infants to be comfortable and to sleep soundly.

Hence, the research hypothesis (H1) which stated that premature infants who receive SCB will have better sleep state variables than those who do not and that there will be a statistically significant difference between the study and control group was justified.

Premature infants may spend longer duration in the NICU and are exposed to an environment very different from that in utero. This can lead to short-term sequelae, like changes in HR, RR, blood pressure, and SpO2 levels **(Sumathy, 2020)**.

The result of the present study illustrated that, the difference between two groups were statistically insignificant pre SCB intervention, however post-intervention the improvement in normal physiological parameters was observed as a significant increase in the number of premature infants changed to normal range and stable HR, RR, body temperature and normal range of arterial blood SpO2 level of premature infants in the study group compared with the control group. The differences between two groups was highly statistical significant at post-intervention.

These current study results are in accordance with those of **Parsa et al., (2018),** who conducted a study about "The effect of kangaroo mother care (KMC) on physiological parameters of premature infants in Hamadan City, Iran", they stated that, premature infants in KMC group display stable physiological measurement including HR, RR, and $SpO_2$ level compared to those in the control group with a difference was statistically significant. Another study carried out by **Ranjan and Malik (2019)** entitled "Effect of kangaroo mother care on physiological parameters in low birth weight neonates", in India, they reported that KMC had various physiological effects in term of body temperature, HR, RR, and $SpO_2$. Moreover, **Changrani and Menahem (2021)** whose study on "Physiological and psychological outcomes of kangaroo mother care of preterm infants: An overview", in Australia, found that, there is a significant difference in the physiological measurements of premature infant after the fifth day than the third day of kangaroo mother care.

This may be related to that SCB is effective in maintaining stable physiological parameters of premature infants, as stable physiological parameters of premature infants can be achieved through correct positioning and use of KC. As well, the SCB measures tend to

enhance physiological aspects of circulation and make pain relief easier. which leads to maintaining stable physiological parameters of premature infants.

So, the research hypothesis (H2) which stated that, premature infants who receive SCB will have more stable physiological parameters than those who do not receive it and that there will be a statistically significant difference between the study and control groups was accepted.

During hospitalization of premature infant in the NICU, parents of face high levels of stress, a sense of powerlessness, and frequently lack the necessary expertise to interact with their premature infant **(Franck et al., 2019)**. Mothers of premature infants admitted to the NICU need information to engage in the treatment process **(Zakaria et al., 2020)**. In accordance to mothers' knowledge about SCB, the present study result demonstrated that, the majority of the mothers in the study group and three quarter in the control group had poor knowledge about the SCB and the difference between two groups were statistically insignificant before the intervention. This result is congruent with that of **Aldirawi et al., (2019)** whose study entitled "Mothers' knowledge of health caring for premature infants after discharge from neonatal intensive care units in the Gaza Strip, Palestine", they concluded that mothers' knowledge about premature infant's care not at the optimal level, that could place the neonates at danger. This may be attributed to mothers who did not receive any information about SCB intervention.

In contrast to the mothers in the control group, who continued to poor knowledge, less than three-quarters of the mothers in the study group had good knowledge following the SCB intervention. There was a high statistical significant difference between both groups at post-intervention. This finding is consistent with a similar study conducted by **Lee et al., (2019)** who studied "Feasibility of a guided participation discharge program for very preterm infants in a neonatal intensive care unit: A randomized controlled trial, in Chinese", they study discovered that education programs for parents of premature infant throughout the hospitalization period helped to increase parental know about parenting. Similarly, a study conducted by **El-Hadary et al., (2020)** in Egypt entitled "Impact of discharge educational program on preterm infants' mothers' knowledge and practice", revealed that mothers in the study group had higher levels of knowledge and practice regarding how to care for their premature infants than mothers in the control group following the implementation of the discharge educational program.

This was explained by the point view of the researchers as the study group who received knowledge about SCB in caring for their premature infants they had more chances to receive information, so they got a higher level of knowledge.

Self-confidence is important for mothers to successfully carry out their roles. Concerning mothers' self-efficacy, the present study findings reflected that, the majority of the mothers in the study group and a higher majority in the control group were lower self-efficacy before SCB intervention and the difference between two groups were statistically insignificant. Interestingly, after intervention it was noticed that, a majority in the study changed to higher self-efficacy compared with most of the studied mothers in the control group who continued lower self-efficacy. The difference was highly statistically significant between both groups after intervention.

This study result is consistent with a similar study carried by **Premji, et al., (2018)** who clarified that mothers felt more confident when they were supplied with an chance to learn about the principles of premature infant care as breastfeeding, changing diapers, and measuring the body temperature. In addition, **Gomes et al., (2021)** who in a recent study, highlighted that mother's knowledge of how to effectively handle problems and provide necessary care during this period can have a significant impact on her confidence in caring for neonates and help dispel myths and traditions surrounding the subject.

These results might be explained by the researchers in the light of the fact that, mothers who participated in the SCB, might feel supported so that, they have more confidence, also believes that SCB gave the mothers chances to practice what they had learned, and supplying with a proper feedback to their replies after a face to face meeting using the PowerPoint slides improved their information toward their infants' care, that interfere to improvements of mothers self-efficacy.

As well, this might be attributed to the increase of mothers' knowledge that helps understand how to provide care for the premature infant which leads to increase of self-efficacy.

The above mentioned results proved the hypothesis ($H_3$) which indicated that, there will be a significant improvement in knowledge scores of mothers and mean maternal self-efficacy scores after SCB intervention in the study group than those in the control group.

Concerning the correlation between the mothers' total knowledge and the total perceptions of their self-efficacy scores pre and post-intervention, the present results displayed that, there was a statistical significant positive correlation between mothers' knowledge and their self-efficacy scores before and after interventions in both groups.

This study finding is supported by that of **Jang and Ju (2020).** Accordingly, it could be concluded that, the program designed in this study give mothers knowledge about premature infants. Regular counseling and education was beneficial for enhancing parenting confidence and the quality of premature infant care will be promoted by developing novel nursing management, they also said that, providing mothers with knowledge on premature infants' care and regular counseling were effective for improving parenting confidence.

Hence, the research hypothesis ($H_4$) which revealed that, there will be a significant correlation between mothers' knowledge and self-efficacy was accepted.

Finally, by evaluating the effect of SCB on premature infants and their mothers, improvements of sleep variables, physiological parameters, mothers' knowledge, and self-efficacy scores were observed after implementation of SCB intervention.

## Conclusion

The findings of the current study concluded that the use of SCB enhanced sleep variables and physiological parameters of premature infants, as well, it increased of studied mothers' level of knowledge and self-efficacy scores in the study group than in the control group. As well, there were statistical significant differences between two groups. These results supported the proposed study hypotheses.

## Recommendations

On the basis of the study's findings, the following recommendations are proposed:

- There is a need to implement strategies of supportive care like positioning, gentle touch, non-nutritive sucking, hunger cues, oral sucrose, and feeding cues, facilitated tucking, modulating infant states and KC in NICU, to provide more appropriate infant state of alertness, posture, comfort, and keep stable physiological parameters.
- How to safeguard and observance the sleep of premature infants in the NICU, and how to dully evaluate and implement useful care measures have become significant issues to keep into consideration in the conducted research for enhancing premature infant development.
- Develop an premature infant care education program for mothers about care of premature infants to improve their knowledge and self-efficacy.
- NICU clinicians should use the SCB components (positioning, gentle touch, non-nutritive sucking, hunger cues, oral feeding and feeding cues, facilitated tucking, modulating infant states and KC) into clinical practice, which might safeguard the integrity of sleep and enhance sleep quality for premature infants.

- NICUs clinicians can foster a healing environment to safeguard sleep and care for premature infants.

- Future studies should be conducted with a varied characteristics, from numerous medical centers, and larger sample size to boost the popularization of the study results.

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